(12) UK Patent Application (19) GB (11) 2 238 672 (13) A

(43) Date of A publication 05.06.1991

(21) Application No 9021352.1

(22) Date of filing 01.10.1990

(30) Priority data
(31) 8926073 (32) 17.11.1989 (33) GB

(51) INT CL[5]
H01R 13/70, F42B 3/10

(52) UK CL (Edition K)
H2E ECAA
F3A AC5D2
U1S S1142 S1200

(56) Documents cited
GB 1197299 A EP 0318644 A2 EP 0232981 A1
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(58) Field of search
UK CL (Edition K) F3A, H2E
INT CL[5] F42B, H01R

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(54) Shunting device for use in electrical connectors

(57) A shunting device 12 for an electrical connector 4 with a plug-in connection 10 wherein a short-circuit is automatically eliminated upon connection of a plug-in connector 10 to the mating connector 4. The shunting device has contact means 22 which extend between contact members 2 of the electrical connector 4. Each contact means is resiliently biased towards a respective contact member, thereby ensuring that an adequate contact force is provided. The shunting device has a camming means 24 provided proximate thereto; the camming means between the open position and the closed position shown. The contact means 22 are moved along the camming means 24 by projections 36 on plug-in connector 10 and are self biassed back to the closed position shown, while wiping the contact members 2. The contact means 22 are straight wire ends shorted by coiled wire 32 that is bent to provide the camming means 24. Make before break (and the reverse) are effected to protect the fuse of an igniter for a vehicle air bag.

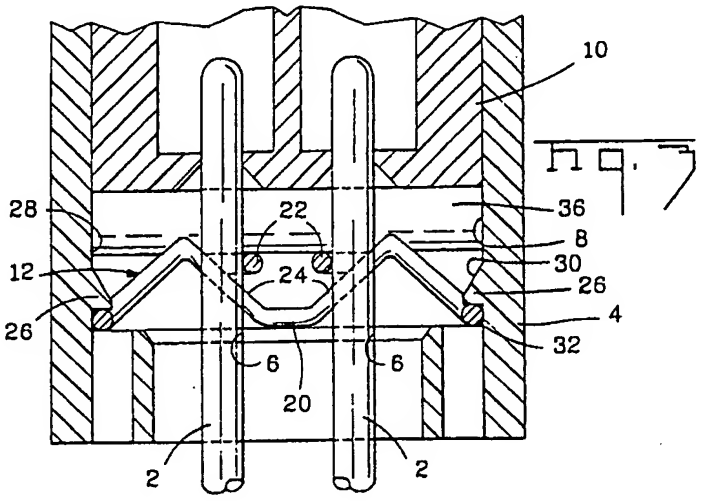

Fig. 7

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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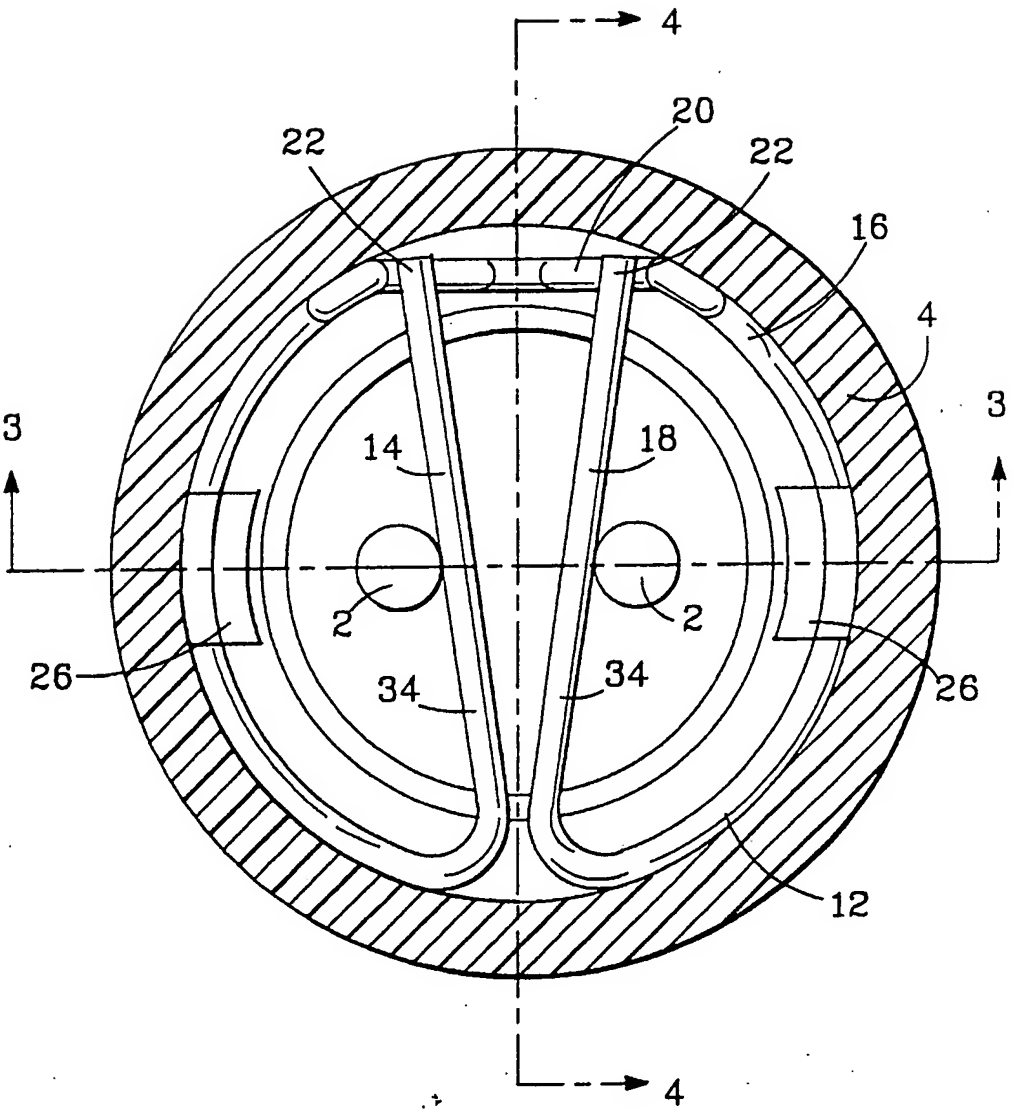

Fig. 1

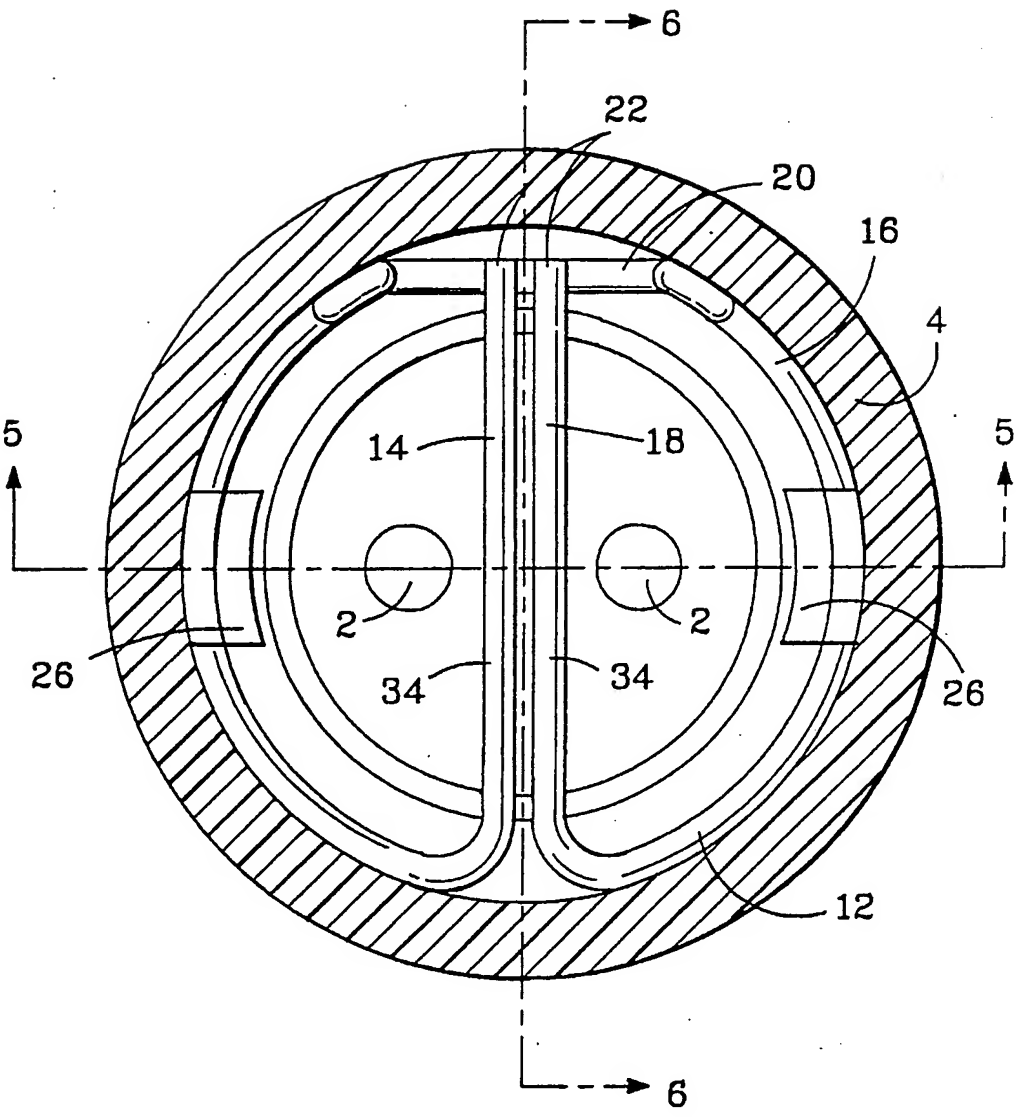

Fig. 2

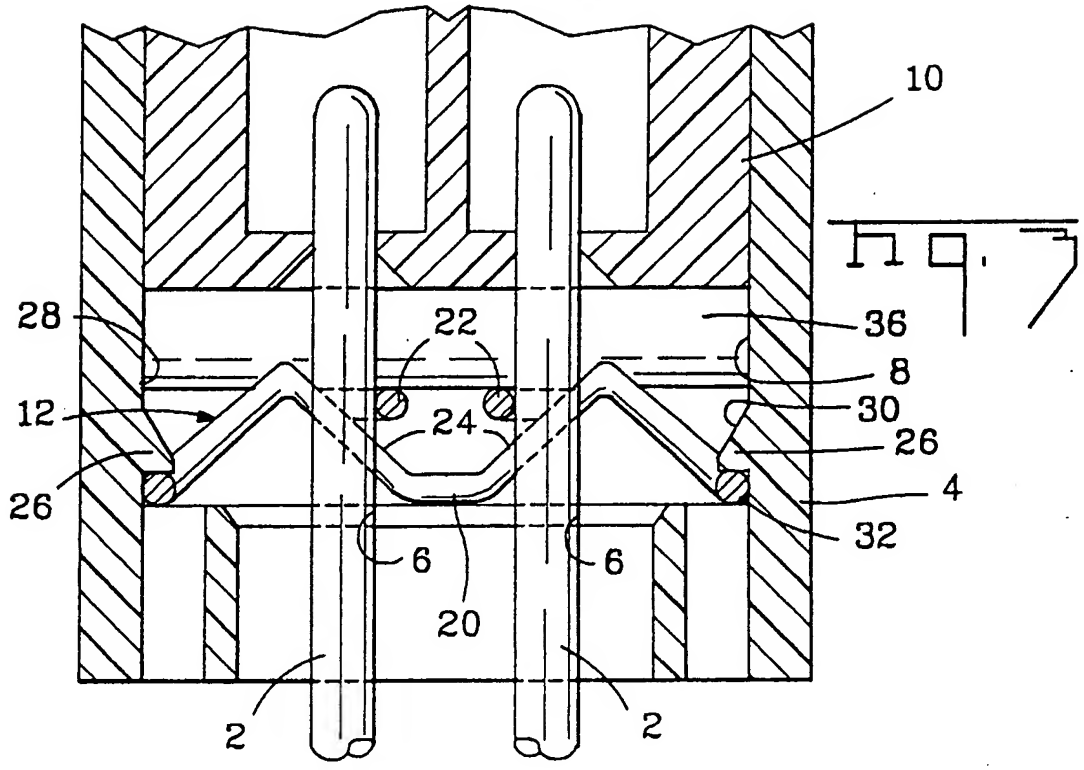
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Fig. 3

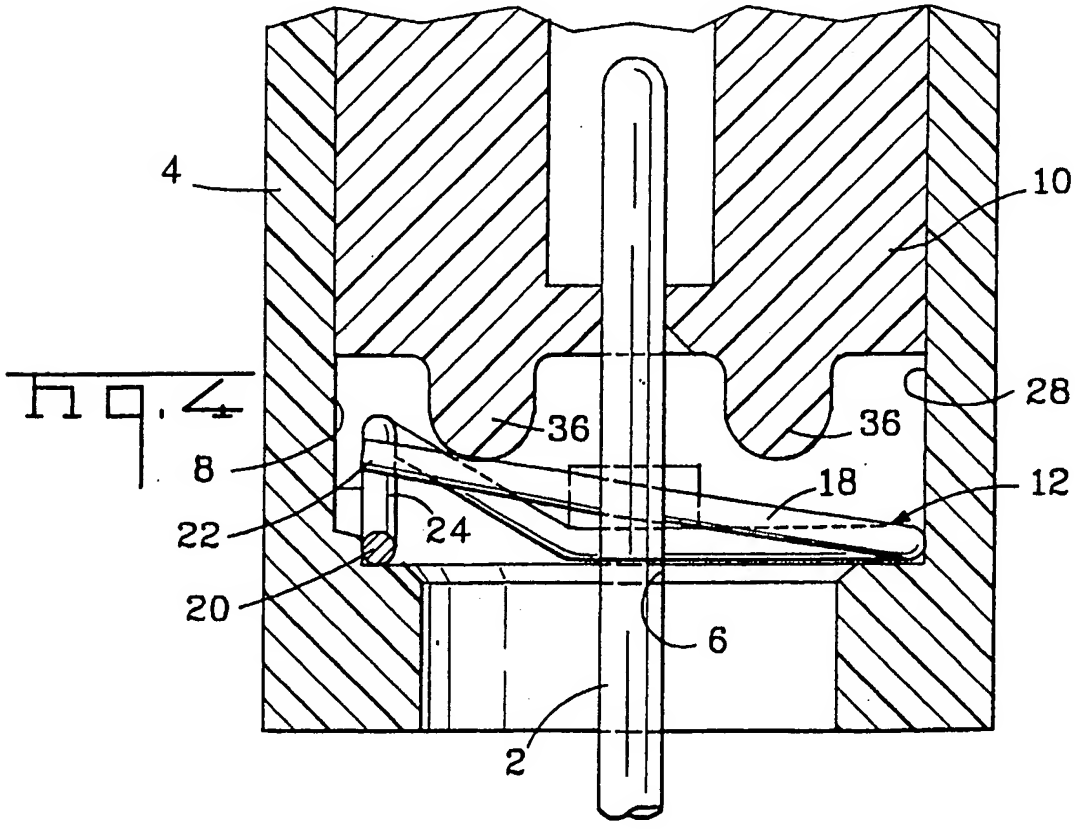
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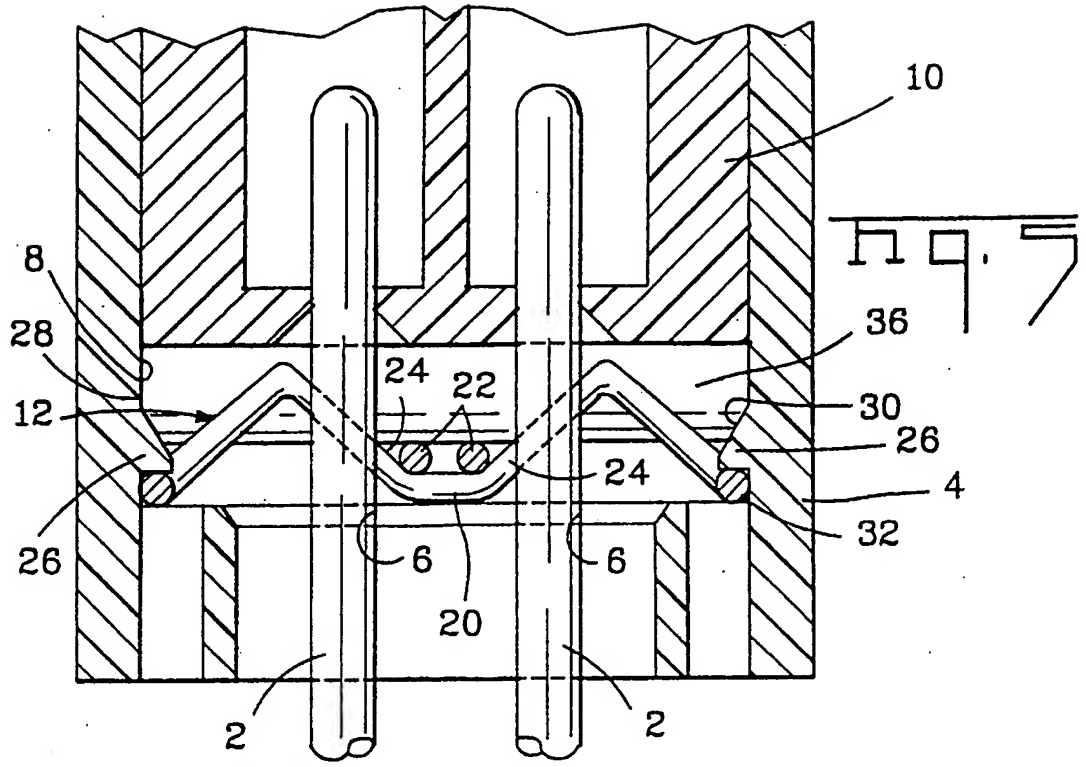
Fig. 4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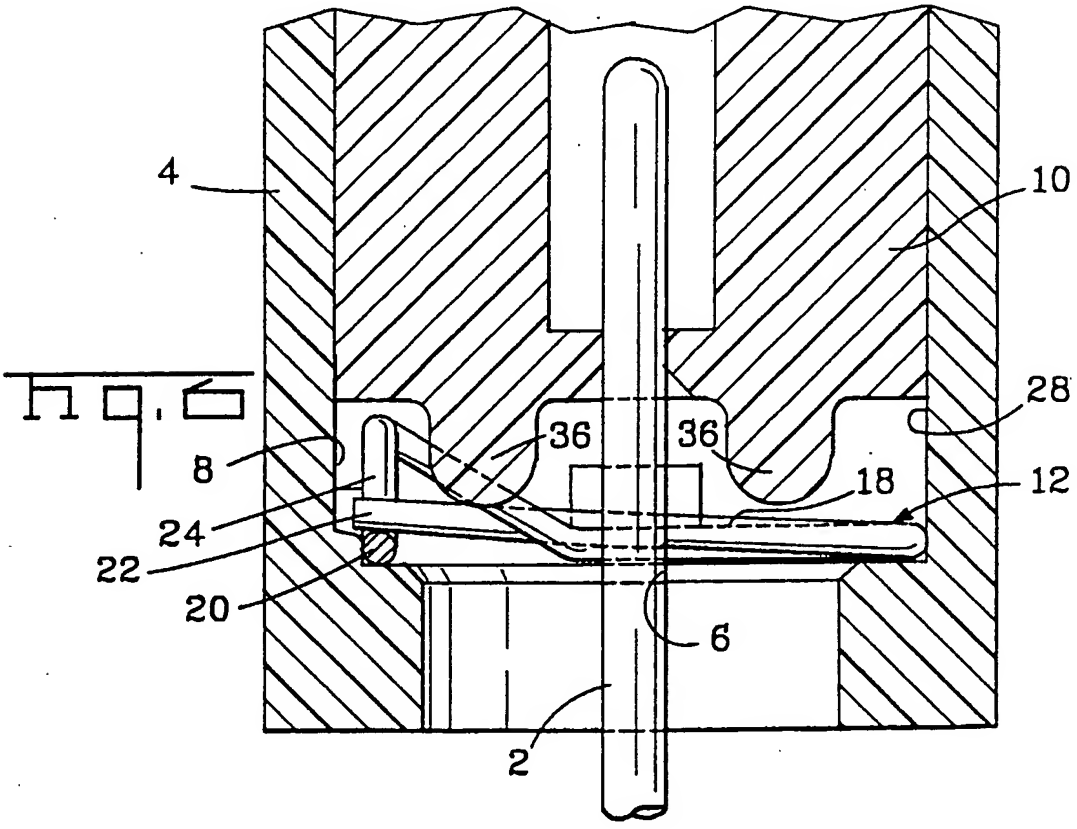
Фиг. 5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Фиг. 6

SHUNTING DEVICE FOR USE IN ELECTRICAL CONNECTORS

The invention relates to a short-circuit fuse or shunting device which automatically engages terminals of a connector when the connector is nonoperational. In particular, the invention is directed to a shunting device for use in an ignition device, such as an air bag, the shunting device insures that the ignition device will only be activated when required.

Various forms of igniters have been proposed for igniting propellant or charges. Many of these igniters have insulated connector leads which are connected to an igniter element, such as an electrically conductive bridge in the form of fine metal filaments, or any other number of configurations. However, these igniters have a major problem associated therewith, the igniters can be triggered prior to the connector halves being mated together. This problem is magnified as the sensitivity of the igniter increases.

As an example, in automobiles equipped with an air bag system, a highly sensitive igniter, with a relatively brief response time, is required. The igniter must have a brief response time since, in case of a collision of the automobile, the igniter must effect ignition of the air bat system in fractions of a second in order to insure the inflation of the air bags. However, the system must be reliable in order to insure that the unintended ignition of the air bags does not cause harm.

To prevent the unintended triggering of igniters, a number of connectors have been designed to provide a short-circuiting of the contacts when the igniter is in a nonoperational condition. One such configuration is shown in German Patent Number 562,732, which discloses a bracket-shaped fuse. In operation, the bracket-shaped

fuse is severed or removed after the conductors of the igniter are electrically connected.

The problem with this type of solution, is that unsafe conditions occur during the installation of the igniter system, and particularly when the fuse is removed from the connector. During the existence of such unsafe conditions, an unintended explosion or triggering can readily take place.

In German Patent Number 502,758, a fuse design is disclosed in which the short circuit is automatically eliminated when the igniter is connected to a current conducting line, and is reestablished when the connection is interrupted. However, this fuse has a very complicated structure and, in view of the small dimensions required for igniters, the required individual parts must be manufactured with extreme mechanical precision so that extremely high production costs must be incurred.

U.S Patent 4,369,707 teaches of a short circuit fuse which is relatively easy to manufacture and which provides for the short circuit to be automatically deactivated when the igniter is connected to the ignition circuit and automatically reactivated when the igniter is disconnected from the ignition circuit. However, several problems are present in this design. The resilient characteristics of the short circuit fuse depend upon the cooperation of the fuse with the housing. Consequently, in order for the fuse to function properly (i.e. for the fuse to be resiliently maintained in contact with the electrodes), the tolerances of the housing and the fuse must be held within various limits. Also, as the fuse is stamped and formed from metal stock, the contact point provided between the fuse and the terminal of the igniter is not precisely controlled. This can cause an inadequate electrical connection between the fuse and the terminal, which thereby causes an unsafe condition, in which an

unintended triggering of the device can readily take place.

It would therefore prove advantageous to provide a short circuit or shunting device which automatically deactivates when the igniter is connected to the ignition circuit and automatically reactivates when the igniter is disconnected from the ignition circuit, and which has the resilient and electrical characteristics to be reliable over many cycles. It would also be beneficial to provide a resilient shunting device in which the shunting device has means provided thereon for insuring that a positive electrical connection is provided between the device and the electrodes of the igniter.

The invention is directed to a shunting device for use in an electrical connector. The shunting device is adapted to automatically eliminate a short-circuit upon the mating of a mating connector with the electrical connector. Contact means are provided on the shunting device, the contact means cooperate with contact members of the electrical connector to place the contact means in a closed position when the mating connector is not inserted into the electrical connector, and the contact means do not cooperate with the contact members to place the contact means in an open position when the mating connector is inserted into the electrical connector.

The shunting device is characterized by camming means provided proximate thereto. The camming means cooperate with the contact means to move the contact means between the open position and the closed position.

In another aspect of the invention, the contact means of the shunting device extend between the contact members of the electrical connector. Each contact means is resiliently biased toward a respective contact member.

12/7/2007, EAST Version: 2.1.0.14

In order that the present invention may be more readily understood, reference will now be made, by way of example, to the accompanying drawings, in which:-

FIGURE 1 is a cross-sectional view of the electrical connector showing the short-circuit fuse or shunting device of the present invention in an activated or safety position.

FIGURE 2 is a cross-sectional view of the electrical connector, similar to that of Figure 1, showing the shunting device in a deactivated or ignition position.

FIGURE 3 is an axial cross-sectional view, taken along line 3-3 of Figure 1, showing the shunting device in the activated or safety position.

FIGURE 4 is an axial cross-sectional view, taken along line 4-4 of Figure 1, showing the shunting device in the activated or safety position.

FIGURE 5 is an axial cross-sectional view, taken along line 5-5 of Figure 2, showing the shunting device in the deactivated or ignition position.

FIGURE 6 is an axial cross-sectional view, taken along line 6-6 of Figure 2, showing the shunting device in the deactivated or ignition position.

Referring to Figures 3 to 6, pin shaped electrodes 2 are provided in a dielectric housing 4. The electrodes 2 extend to an igniter element, which is not shown. The electrodes are insulated from each other, and are positioned in openings 6 of housing 4. The positioning of the electrodes 2 in the openings 6 provides the means to accurately position and maintain the electrodes in the housing. As is best shown in Figures 3 to 6, the housing 4 extends beyond the electrodes 2 to form a socket 8. The socket 8 serves to protect the electrodes 2 against a bending deformation and also serves as a guide means for guiding a contact or connector plug 10 into the housing 4. The socket 8 also cooperates with the shunting contact 12, to maintain the shunting contact

12 proximate the electrodes 2, as will be more fully discussed.

The shunting contact 12 is a round wire spring contact which has the desired electrical and mechanical characteristics. It is worth noting that various other types of shunting contacts may be used without departing from the invention. As viewed in Figure 1, the shunting contact 12 has a first section 14 which electrically engages the one respective electrode 2, a third section 18 which electrically engages the other respective electrode 2, and a second section 16 which electrically and mechanically connects the first section to the third section. The second section has a generally circular configuration which has a flat portion 20 provided proximate the free ends 22 of the first and third sections.

Referring to Figures 3 and 4, the relative elevations of the first, second, and third sections 14, 16, 18 are shown. The first and third sections 14, 18 extend from the second section at an angle therefrom. Figure 4 illustrates the incline at which the sections 14, 18 are positioned when the sections are in an unstressed position. The second section 16 also has inclined portions associated therewith. The inclined portions of the second section are provided proximate the flat portion 20 thereof. Surfaces 24 of inclined portions of the second section 16 act as camming surfaces which cooperate with the free ends 22 of the first and third sections 14, 18.

The shunting contact 12 is provided proximate electrodes 2 in the socket 8 of housing 4. In order to maintain the shunting contact 12 in the socket 8, latching projections 26 project into the socket 8 from sidewalls 28 thereof. The projections 26 have lead-in surfaces 30 and shoulders 32, the shoulders cooperate with the contact 12, as shown in Figures 3 and 4, to maintain the contact in

the socket 8. In order to position the shunting contact 12 in the socket 8, the shunting contact is inserted through the top of the socket 8 and pushed downward. As the motion is continued, the second section 16 of the shunting contact slides along the lead-in surfaces 30 of projections 26. This causes the second sections to resiliently deform inwardly. This continues until the shunting contact 12 is moved beyond the projections 26. At this point the second section of the shunting contact will resiliently return to an unstressed position. In this position, as best shown in Figure 4, the second section cooperates with the shoulders 28 to maintain the shunting contact 12 in the socket 4.

With the electrodes 2 and shunting contact 12 properly positioned in the housing 4, the shunting contact 12 provides the electrical connection required between the respective electrodes. It is worth noting that the first and third sections of the shunting contact are provided between the electrodes. This is important in applications in which the size of the connector housing must be minimized. As shown in Figure 1, 3 and 4, when the shunting contact 12 is in the safety or activated position, contact surfaces 34 of the first and third sections 14, 18 electrically engage the electrodes 2. The electrical connection is insured because the contact surfaces 34 are resiliently maintained against the electrodes 2. In other words, when the shunt contact 12 is in the activated position, the first and third sections are provided in a stressed position. As the electrodes prevent the first and third sections from moving to the unstressed position, the shunt contact provides a contact force between the first and third sections and the electrodes, thereby insuring that a positive electrical connection is effected.

This short circuit or shunting position prevents static charges from effecting the electrodes, and thereby prevents the unwanted triggering of the igniter element.

As the connector plug 10 is mated with the housing 4, the electrodes 2 are positioned in electrical engagement with the mating contacts (not shown) of the plug 10. With the electrodes and mating contacts provided in electrical engagement, the insertion of the plug 10 into the socket 8 of the housing 4 is continued. This causes ribs 36 of the plug to engage the first and third sections 14, 18 of the shunting contact 12 proximate the free ends 22 thereof.

As the insertion continues, the ribs 36 force the first and third sections downward, as shown in Figure 5 and 6. As this downward motion occurs, the free ends 22 of the first and third sections 14, 18 are forced into engagement with the camming surfaces 24. The camming surfaces cooperate with the free ends to move the free ends toward each other. Consequently, the downward motion of the plug 10 is translated into a downward and inward motion of the first and third sections of the shunting contact. This motion is continued until the free ends 22 are provided in engagement with the flat portion 20 (Figure 6) of the shunting contact 12, such that the connector plug 10 is provided in the position shown in Figures 5 and 6. As best shown in Figures 2 and 5, when the plug is fully inserted into the socket, the contact surfaces 34 of the first and third sections are disengaged from the electrodes 2. This defines the deactivated position.

If the connector plug 10 is to be removed from the socket 8, the plug 10 is moved upward from the position shown in Figures 5 and 6 to the position shown in Figures 3 and 4 and beyond. As this occurs, the first and third sections 14, 18 of the shunting contact are allowed to resiliently return to the position shown in Figures 1, 3

and 4. As the sections return, the contact surfaces 34 are forced to slide across a portion of a surface of the electrodes 2, thereby providing a wiping action which insures that a positive electrical connection is effected between the electrodes and the shunting contact. As was previously discussed, the first and third sections remain in a stressed position to insure that an adequate contact force is supplied between the contact surfaces 34 and the electrodes 2.

The removal of the connector plug is continued until the contacts of the plug are disengaged from the electrodes, and finally until the plug is removed from the socket. It is important to note that the electrical engagement of the shunting contact with the electrodes occurs before the contacts of the plug and the electrodes are disengaged. This prevents the possibility of unintended triggering.

Several advantages are provided by the configuration of the shunting contact described herein. By using a wire contact, the contact points between the shunting contact and the electrodes can be controlled. As both the shunting contact and the electrodes have a circular cross-section, the contact surface therebetween is essentially a contact point. A positive electrical connection s insured at this contact point because the shunting contact extends at essentially a ninety degree angle from the electrode when they are mated, and due to the wiping action incurred therebetween.

Another advantage of the configuration of the shunting contact relates to the resiliency thereof. The shunting contact is configured such that the resiliency required for operation is provided by the contact material and the shape of the contact. In other words, the resiliency does not depend on the interaction of the contact with the housing. As this interaction is not

critical, the tolerances associated with the housing and the contact become less critical. Consequently, as the tolerance limits do not have to be as accurately controlled, the manufacture of the contacts and housings can be done quickly and cheaply.

CLAIMS:

1. A shunting device for use in an electrical connector, the shunting device being adapted to automatically eliminate a short-circuit upon the mating of a mating connector with the electrical connector, the shunting device having contact means provided thereon, the contact means cooperate with contact members of the electrical connector to place the contact means in a closed position when the mating connector is not inserted into the electrical connector, and the contact means do not cooperate with the contact members to place the contact means in an open position when the mating connector is inserted into the electrical connector, the shunting device being characterized in that:

the shunting device has camming means provided proximate thereto, the camming means cooperating with the contact means to move the contact means between the open position and the closed position.

2. A shunting device as set forth in claim 1, wherein the camming means is integral with the shunting device.

3. A shunting device as set forth in claim 2, wherein the camming means is engaged as the mating connector is mated with the electrical connector, such that the contact means is moved from the contact members after the contact members are placed in electrical engagement with mating contact members of the mating connector.

4. A shunting device as set forth in claim 3, including a second resilient section which has first and third sections which extend therefrom, the second section having the camming means provided thereon, and the first and third sections having the contact means integral therewith.

5. A shunting device as set forth in claim 4, wherein the contact means has contact surfaces provided on the first and third sections, the contact surfaces extend in a plane which is essentially parallel to the plane of the contact members.

6. A shunting device as set forth in claim 4, wherein the camming means have inclined surfaces provided on the second section, the inclined surfaces cooperate with free ends of the contact means to move the contact means.

7. A shunting device as set forth in claim 1, wherein the shunting device is formed from drawn wire having the appropriate electrical and resilient characteristics.

8. A shunting device as set forth in claim 2, wherein the contact means are moved from the open position to the closed position, the resiliency of the shunting device causes the shunting device to slide across the contact members, thereby insuring that a positive electrical connection is effected therebetween.

9. A shunting device as set forth in claim 1, wherein in the closed position, the contact means are provided in a stressed position, thereby insuring that the contact means will exert a sufficient contact force on the contact members of the electrical connector.

10. A shunting device for use in an electrical connector, the shunting device being adapted to automatically eliminate a short-circuit upon the mating of a mating connector with the electrical connector, the shunting device having contact means provided thereon, the contact means cooperate with contact members of the electrical connector to place the contact means in a closed position when the mating connector is not inserted

into the electrical connector, and the contact means do not cooperate with the contact members to place the contact means in an open position when the mating connector is inserted into the electrical connector, the shunting device being characterized in that:

the contact means of the shunting device extend between the contact members of the electrical connector, each contact means being resiliently biased toward a respective contact member.

11. A shunting device as set forth in claim 10 further characterized in that the shunting device has camming means provided proximate thereto, the camming means cooperate with the contact means to move the contact means between the open position and the closed position.

12. A shunting device as set forth in claim 11 further characterized in that the camming means is integral with the shunting device.

13. A shunting device as set forth in claim 12 further characterized in that the camming means is engaged as the mating connector is mated with the electrical connector, such that the contact means is moved from the contact members after the contact members are placed in electrical engagement with mating contact members of the mating connector.

14. A shunting device as set forth in claim 10 further characterized in that the shunting device is formed from drawn wire having the appropriate electrical and resilient characteristics.

15. A shunting device as set forth in claim 10 further characterized in that as the contact means are moved from the open position to the closed position, the resiliency of the shunting device causes the shunting device to slide across the contact members, thereby insuring that a positive electrical connection is effected therebetween.

16. A shunting device constructed and adapted to operate substantially as hereinbefore described with reference to the accompanying drawings.

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